Claims

[1] A III-nitride compound semiconductor light emitting device comprising:
an active layer emitting light and being interposed between a lower contact layer made of n-GaN and an upper contact layer made of p-type III-nitride compound semiconductor layer,
an n-type electrode layer formed on the lower contact layer,
a lattice mismatch-reducing layer made of $In_xGa_{1-x}N(x>0)$, grown on the lower contact layer and having a thickness of 200-1000Å,
an electron supply layer made of n-$Al_yGa_{1-y}N(y\geq 0)$ and grown on the lattice mismatch-reducing layer, and
a crystal restoration layer made of $In_zGa_{1-z}N(z>0)$, grown on the electron supply layer and in contact wiht the active layer.

[2] The III-nitride compound semiconductor light emitting device of Claim 1, wherein the active layer has a single-quantum-well or multiple-quantum-well structure comprising quantum well layer made of $In_xGa_{1-x}N$.

[3] The III-nitride compound semiconductor light emitting device of Claim 1, wherein the active layer has a multiple-quantum structure composed of an alternate stacking of quantum well layers and quantum barrier layers and the lattice mismatch-reducing layer has an energy band gap larger than the energy band gap of the quantum well layers and smaller than the energy band gap of the quantum barrier layers.

[4] The III-nitride compound semiconductor light emitting device of Claim 1, wherein the lattice mismatch-reducing layer is undoped.

[5] The III-nitride compound semiconductor light emitting device of Claim 1, wherein the indium content of the lattice mismatch-reducing layer is $0<x\leq 0.4$.

[6] The III-nitride compound semiconductor light emitting device of Claim 1, wherein the Al content of the electron supply layer is $0<y\leq 0.2$.

[7] The III-nitride compound semiconductor light emitting device of Claim 1, wherein the electron supply layer has a thickness of 10-500Å.

[8] The III-nitride compound semiconductor light emitting device of Claim 1, wherein the doping concentration of the electron supply layer is 5×10^{17}-10×10^{21} atoms/cm^3.

[9] The III-nitride compound semiconductor light emitting device of Claim 1, wherein the active layer has a multiple-quantum-well structure composed of an alternate stacking of quantum well layers and quantum barrier layers and the crystal restoration layer has an energy band gap larger than the energy band gap of the quantum well layers and smaller than the energy bandgap of the quantum

barrier layers.

[10] The III-nitride compound semiconductor light emitting device of Claim 1, wherein the crystal restoration layer has a thickness of 10-500Å.

[11] The III-nitride compound semiconductor light emitting device of Claim 1, wherein the crystal restoration layer is undoped.

[12] The III-nitride compound semiconductor light emitting device of Claim 1, wherein the indium content of the crystal restoration layer is $0<z\leq0.4$.

[13] The III-nitride compound semiconductor light emitting device of Claim 1, comprising:
an electron acceleration layer made of n-GaN or undoped GaN and grown on the lower contact layer, and
a heterojunction electron barrier-removing layer made of a higher doping concentration of n-GaN than that of the electron acceleration layer and grown on the electron acceleration layer,
wherein the lattice mismatch-reducing layer is grown on the heterojunction electron barrier-removing layer.

[14] The III-nitride compound semiconductor light emitting device of Claim 13, wherein the doping concentration of the electron acceleration layer is 1×10^{15} - 1×10^{18} atoms/cm^3 when the electron acceleration layer is made of n-GaN.

[15] The III-nitride compound semiconductor light emitting device of Claim 13, wherein the electron acceleration layer has a thickness of 100-10000Å.

[16] The III-nitride compound semiconductor light emitting device of Claim 13, wherein the doping concentration of the heterojunction electron barrier-removing layer is 1×10^{18}-1×10^{21} atoms/cm^3.

[17] The III-nitride compound semiconductor light emitting device of Claim 13, wherein the heterojunction electron barrier-removing layer has a thickness of 10-300Å.

[18] The III-nitride compound semiconductor light emitting device of Claim 13, wherein the heterojunction electron barrier-removing layer is a delta-doping layer.

[19] The III-nitride compound semiconductor light emitting device of Claim 1, wherein a sequential stack of an electron acceleration layer made of n-GaN or undoped GaN and a heterojunction electron barrier-removing layer is interposed between the lower contact layer and the lattice mismatch-reducing layer, and the heterojunction electron barrier-removing layer is composed of an alternate stack in a superlattice form of a first layer made of n-GaN having a higher doping concentration than that of the electron acceleration layer and a second layer made of undoped GaN or n-GaN having a lower doping concentration than that of the

first layer.

[20] The III-nitride compound semiconductor light emitting device of Claim 19, wherein the thickness of each of the first and second layer is 5-150Å and the thickness of the heterojunction electron barrier-removing layer is 20-500Å.